SECTION 15990

TESTING, ADJUSTING, AND BALANCING

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. This section defines responsibilities of the Contractor, LANL and the Testing, Adjusting and Balancing (TAB) Agency and the TAB Agency's scope of work (Appendix A) in the TAB of heating, ventilating and air conditioning (HVAC) systems.

### 1.2 LANL PERFORMED WORK

A. Testing, adjusting and balancing will be performed by an independent TAB Agency, contracted and directed by LANL under a separate contract.

## PART 2 PRODUCTS

### 2.1 INSTRUMENTS AND EQUIPMENT

A. Contractor is not required to furnish any instruments or equipment used in the TAB Agency services.

## PART 3 EXECUTION

### 3.1 CONTRACTOR'S RESPONSIBILITIES

A. Provide window in project schedule for completion of TAB services prior to final inspection of project.

B. Verify installation of HVAC systems for conformity to Contract Drawings and specifications.

C. Have mechanical, controls, structural and related electrical systems complete and in operational readiness prior to notifying Contract Administrator that project is ready for TAB Agency services and the requirements of 3.1 have been met. Advance notice of not less than 15 calendar days is required.

D. Complete operational readiness, prior to commencement of TAB services, includes:

1. Doors, windows and ceilings are installed.

2. Equipment is operable and in safe and normal condition.

3. Temperature control systems are installed complete and operable. Vendor testing and programming of all system components and the overall system has been completed and test reports accepted by the Construction Inspector.

4. Proper thermal overload protection is in place for electrical equipment.

5. Construction filters have been replaced. The final filters are clean and in-place in respective air handling units.

6. Duct systems are free of debris and clean.

7. Correct fan rotation.

8. Dampers are in place and open.
9. Coil fins have been cleaned and combed.

10. Access doors in ducts are closed.

11. Air outlets are installed and connected.

12. Duct system leakage has been minimized.

13. Duct systems have been leak and pressure tested and test reports accepted by the Construction Inspector.

14. Hydronic systems have been leak tested and test reports accepted by Construction Inspector.

15. Hydronic systems have been flushed, filled and vented.

16. Refrigerant systems have been leak tested and test reports accepted by the Construction Inspector.

17. Correct pump rotation.

18. Remove start-up screens from pump suction diffusers.

19. Strainer baskets are clean and in place.

20. Service and balance valves are open.

E. Put all HVAC systems and equipment into full operation and continue operation during times of testing and balancing.

1. Do not operate equipment until properly lubricated and brought into manufacturer's specified service conditions.

F. Provide labor, i.e., remove ceiling tiles, etc., to access concealed equipment as requested by TAB Agency.

G. Cooperate with TAB Agency and provide labor and materials to make any changes in sheaves, belts and dampers required for correct balance as required by TAB Agency.

H. After TAB Agency is notified and TAB work started, should system(s) be found to not be in readiness or a dispute occurs as to readiness of system(s), the Contract Administrator may require a joint inspection be made by representatives of LANL, the TAB Agency and the Contractor.

1. Should inspection reveal TAB services notification to have been premature, costs of work previously accomplished by TAB Agency shall be paid for by the Contractor.

2. Such items as are not ready for TAB services shall be completed and placed in operational readiness by Contractor, and TAB services shall again be scheduled.

3.2 LANL RESPONSIBILITIES

A. Provide TAB Agency with Contract Drawings, approved submittal data, specifications and supplements required for TAB Agency to accomplish review, inspection and TAB services outlined in this specification.

B. Notify TAB Agency within 48 hours of receipt of written notification from Contractor that system(s) will be ready for testing, adjusting and balancing.

3.3 TAB AGENCY RESPONSIBILITIES

A. Review, inspect, test, adjust and balance system(s), as outlined in this section, to conditions noted in Contract Drawings and specifications.

B. Promptly report to the Construction Project Manager any conditions which prevent system balancing.

C. Cooperate with the Contractor but do not instruct or direct the Contractor in any of the work, but make such reports as are necessary directly to the Contract Administrator.

D. Do not provide any construction labor or materials to modify system(s).

E. Leave system(s) in proper working order; close access doors, close doors to electrical switch boxes, etc. and restore thermostats to specified settings.

3.4 TAB REQUIREMENTS

A. Appendix A defines the scope of work to be performed by TAB Agency, and is included only for the Contractor's information.

APPENDIX A

TAB AGENCY SCOPE OF WORK

1. ADJUSTMENT TOLERANCES

   A. Adjust air handling systems to plus or minus 10 percent of design conditions as indicated in Contract Drawings and specifications.

   B. Adjust hydronic systems to plus or minus 10 percent of design conditions as indicated in Contract Drawing and specifications.

2. MARKING OF SETTINGS

   A. Permanently mark final adjusted position of all balancing valves, dampers and other adjustment devices to allow adjustment to be restored if disturbed in future.

3. SYSTEM ACCEPTANCE

   A. LANL will accept the TAB as complete when TAB final report is approved by the Contract Administrator.

4. SCOPE OF WORK

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**Edit the following to suit project requirements.**
**********

   A. Review plans and specifications prior to installation of mechanical system(s) for any deficiencies in system which could preclude proper TAB of system.

   B. Inspect mechanical system(s) prior to TAB to insure that all specified components which will affect proper execution of such work are installed and are operating properly.

   C. Test, adjust and balance all air moving equipment and all air distribution, exhaust and recirculation systems.

      1. Adjust diffusers, grilles and registers to minimize drafts and noise.

   D. Test, adjust and balance hot water heating systems, chilled water systems and condenser water systems.

      1. Complete air balance before actual water balance begins.

   E. In cooperation with the control manufacturer's representative, test and adjust automatic controls, interlocks, safety devices, etc., associated with HVAC Systems for proper operation and sequencing during heating and cooling modes of operation.

   F. Retest and report the operations of refrigeration systems.

   G. Take sound readings.

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**Specify requirements. Construction and equipment specification must also be properly edited.**
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   H. Take vibration measurements.

**********
**Specify requirements. Construction and equipment specification must also be properly edited.**
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3.5 FINAL REPORT DATA

A. Final report forms shall contain the following minimum data.

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**Edit to suit project requirements (add equipment numbers for clarity if required).**
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B. Air Moving Equipment:

1. Location.
2. Manufacturer.
3. Model.
4. Supply air flow, design and actual.
5. Return air flow, design and actual.
6. Outside air flow, design and actual.
7. Total external static pressure, design and actual.
8. Fan inlet pressure.
9. Fan discharge pressure.
10. Fan RPM.

C. Exhaust Fan Data:

1. Location.
2. Manufacturer.
3. Model.
4. Air flow, design and actual.
5. Total external static pressure, design and actual.
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

D. Return Air/Outside Air Data:

1. Identification/location.
2. Air flow, design and actual.
3. Return air flow, design and actual.

4. Outside air flow, design and actual.

5. Return air temperature, DB and WB.

6. Outside air temperature, DB and WB.

7. Mixed air temperature, design DB and WB.

8. Outside/return air ratio, design and actual.

E. Electric Motors:

1. Manufacturer.

2. Name plate HP/BHP.

3. Phase, voltage, amperage, frequency (when variable frequency speed reduction drive is used) nameplate, actual, no load.

4. RPM, nameplate and actual.

5. Service factor.

6. Starter size, rating, heater element size.

F. Variable Speed Drive:

1. Manufacturer.

2. Type.

3. Name Plate HP/BHP.

4. Voltage, phase, amperage, frequency - name plate, bypass circuit, actual, no load.

G. V-Belt Drive:

1. Identification/location.

2. Required driven RPM.

3. Driven sheave, diameter and actual RPM.

4. Motor sheave, diameter and RPM.

5. Belt, size and quantity.

6. Center to center distance, maximum, minimum and actual.

H. Duct Traverse:

1. System zone/branch.

2. Duct size.

3. Area.

4. Velocity, design and actual.

5. Air flow, design and actual.
6. Duct static pressure.
7. Air temperature.
8. Air correction factor.

I. Air Monitoring Station:

1. Identification/location.
2. System.
3. Size.
4. Area.
5. Velocity, design and actual.
6. Air flow, design and actual.

J. Air Distribution:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Velocity, design and actual.
7. Air flow, design and actual.

K. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.

11. Inlet static pressure.

12. Inlet air temperature, DB and WB.

L. Electric Primary Unit and/or Duct Heater:

1. Manufacturer.

2. Identification/number.

3. Location.

4. Model.

5. Design kW.

6. Number of stages.

7. Phase, voltage, amperage.

8. Test voltage (each phase).

9. Air flow, design and actual.

10. Temperature rise, design and actual.

M. Pump Data:

1. Identification/number.

2. Manufacturer.

3. Size/model.

4. Impeller size.

5. Service.

6. Design flow rate, pressure drop, BHP.

7. Actual flow rate, pressure drop, BHP.

8. Discharge pressure.

9. Suction pressure.

10. Total operating head pressure.

11. Shut off, discharge and suction pressures.

12. Shut off, total head pressure.

N. Cooling Tower:

1. Tower identification/number.

2. Manufacturer.

3. Model.

4. Rated capacity.

5. Entering air WB temperature, design and actual.

6. Leaving air WB temperature, design and actual.

7. Ambient air DB and WB temperatures.

8. Condenser water entering temperature.

9. Condenser water leaving temperature.

10. Condenser water flow rate.

11. Fan RPM.

O. Chillers:

1. Identification/number.

2. Manufacturer.

3. Capacity.

4. Model.

5. Evaporator entering water temperature, design and actual.

6. Evaporator leaving water temperature, design and actual.

7. Evaporator pressure drop, design and actual.

8. Evaporator water flow rate, design and actual.

9. Condenser entering water temperature, design and actual.

10. Condenser leaving water temperature, design and actual.

11. Condenser pressure drop, design and actual.

12. Condenser water flow rate, design and actual.

P. Air Cooled Condenser:

1. Identification/number.

2. Location.

3. Manufacturer.

4. Model.

5. Entering DB and WB air temperature, design and actual.

6. Leaving DB and WB air temperature, design and actual.

7. Number of compressors.

Q. Air cooled condensing unit

1. Identification/Number.
2. Location
3. Manufacturing
4. Model
5. Entering DB and WB air temperature, design and actual.
6. Leaving DB and WB air temperature, design and actual.
7. Number of compressors.

R. Heat Exchanger:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Model.
6. Pressure, design and actual.
7. Primary fluid entering temperature, design and actual.
8. Primary fluid leaving temperature, design and actual.
9. Primary fluid flow, design and actual.
10. Primary fluid pressure drop, design and actual.
11. Secondary fluid entering temperature, design and actual.
12. Secondary fluid leaving temperature, design and actual.
13. Secondary fluid flow, design and actual.
14. Secondary fluid pressure drop, design and actual.

S. Cooling Coil Data:

1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Air pressure drop, design and actual.
7. Entering air DB temperature, design and actual.

8. Entering air WB temperature, design and actual.

9. Leaving air DB temperature, design and actual.

10. Leaving air WB temperature, design and actual.

11. Water flow, design and actual for water coils

12. Water pressure drop, design and actual for water coils.

13. Entering water temperature, design and actual for water coils.

14. Leaving water temperature, design and actual for water coils.

15. Liquid refrigerant pressure (up stream of expansion valve).

16. Gaseous refrigerant pressure (down stream of thermal bulb).

T. Heating Coil Data:

1. Identification/number.

2. Location.

3. Service.

4. Manufacturer.

5. Air flow, design and actual.

6. Air pressure drop, design and actual.

7. Water flow, design and actual.

8. Water pressure drop, design and actual.

9. Entering water temperature, design and actual.

10. Leaving water temperature, design and actual.

11. Entering air temperature, DB, design and actual.

12. Leaving air temperature, DB, design and actual.

U. Flow Measuring Station:

1. Identification/station.

2. Location.

3. Size.

4. Manufacturer.

5. Model.

6. Design flow rate.

7. Design pressure drop.

8. Actual/final pressure drop.

9. Actual/final flow rate.

10. Station calibrated setting.

V. Sound Level Report:

1. Location.

2. Octave bands - equipment off.

3. Octave bands - equipment on.

W. Vibration Test:

1. Location of points on fan(s):

a. Fan bearing, drive end.

b. Fan bearing, opposite end.

c. Motor bearing, center (if applicable).

d. Motor bearing, drive end.

e. Motor bearing, opposite end.

f. Casing (bottom or top).

g. Casing (side).

h. Duct after flexible connection (discharge).

i. Duct before flexible connection (inlet).

2. Location of points on pump(s):

a. Pump bearing drive, end

b. Pump bearing, opposite end

c. Motor bearing, center (if applicable)

d. Motor bearing, drive end

e. Motor bearing, opposite end

f. Housing (bottom or top)

g. Housing (side)

h. Point pipe after flexible connection (discharge)

i. Pipe before flexible connection (suction)

3. Test readings:

a. Horizontal, velocity and displacement.

b. Vertical, velocity and displacement.

c. Axial, velocity and displacement.

4. Normally acceptable readings, velocity and acceleration.

5. Unusual conditions at time of test.

6. Vibration source (if non-complying).

END OF SECTION